

3R and Zero waste principles realization in Sweden.

by

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UNIVERSITY OF BORÅS

Sweden

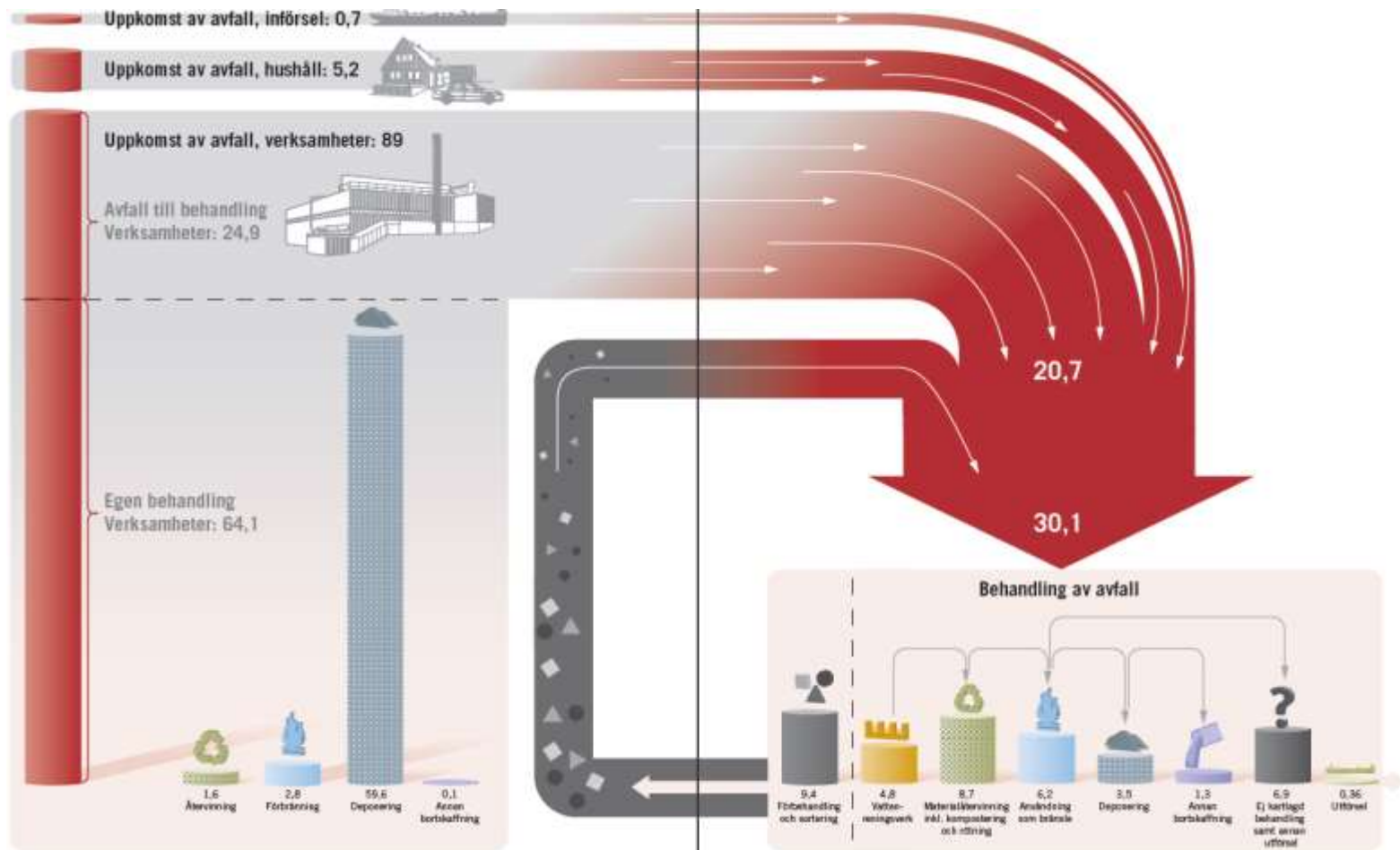
- Population: 9,4 million
- Area: 450 000 km²
- Member of European Union



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Waste flows in Sweden

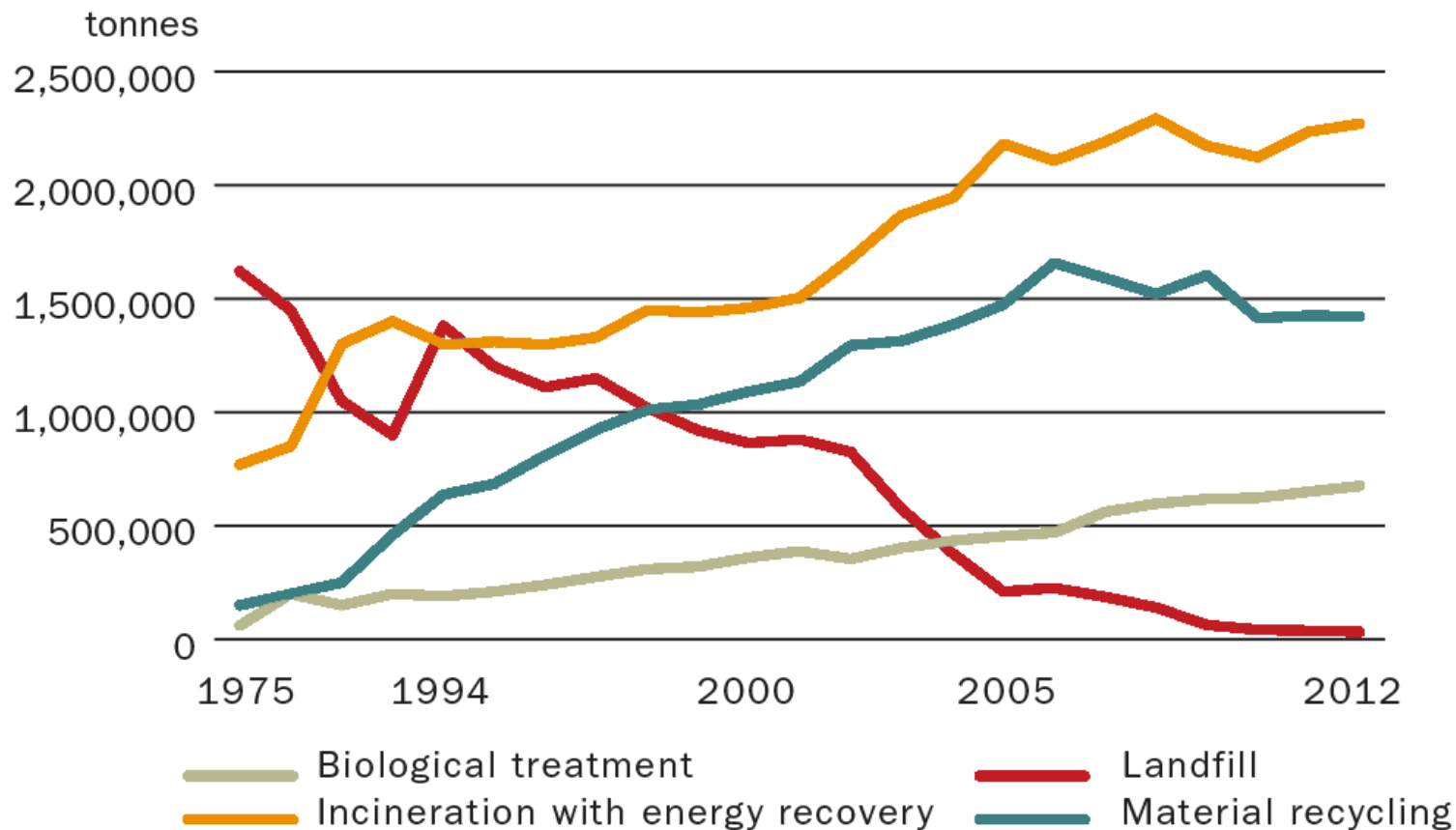


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Treatment of household waste

OVERVIEW 1975-2012



2,6 million tonnes
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4,4 million tonnes
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Political drivers concerning waste

1991 Municipal waste treatment plan

1994 Producers' responsibility

2000 Landfill tax (35 USD/tonne, today 60 USD/tonne)

2000 Landfill ban on combustible waste

2002 EU: Landfill directive

2002 EU: Waste incineration directive

2005 Landfill ban on all organic waste



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Political drivers concerning waste

2006 Incineration tax on combustible waste

2008 Waste Framework Directive (incl waste hierarchy)

2008 EU: All landfills have to fulfill the landfill directive

2010 Incineration tax is removed

2010 50 % of household waste to material recycling (incl biol treatment)

2013 EU: Waste prevention programmes established

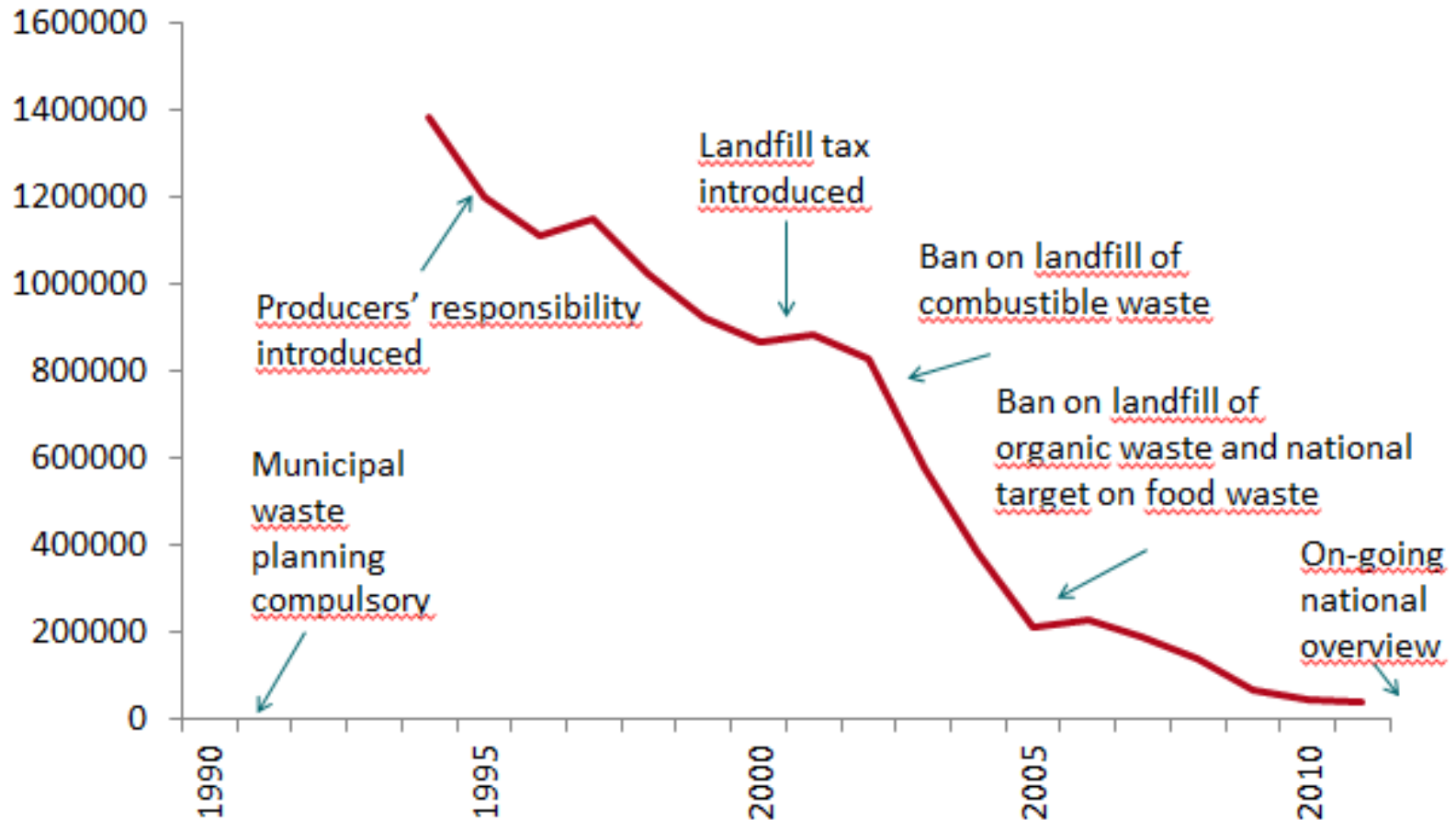
2018 50 % of food waste to biological treatment (40 % energy recovery)



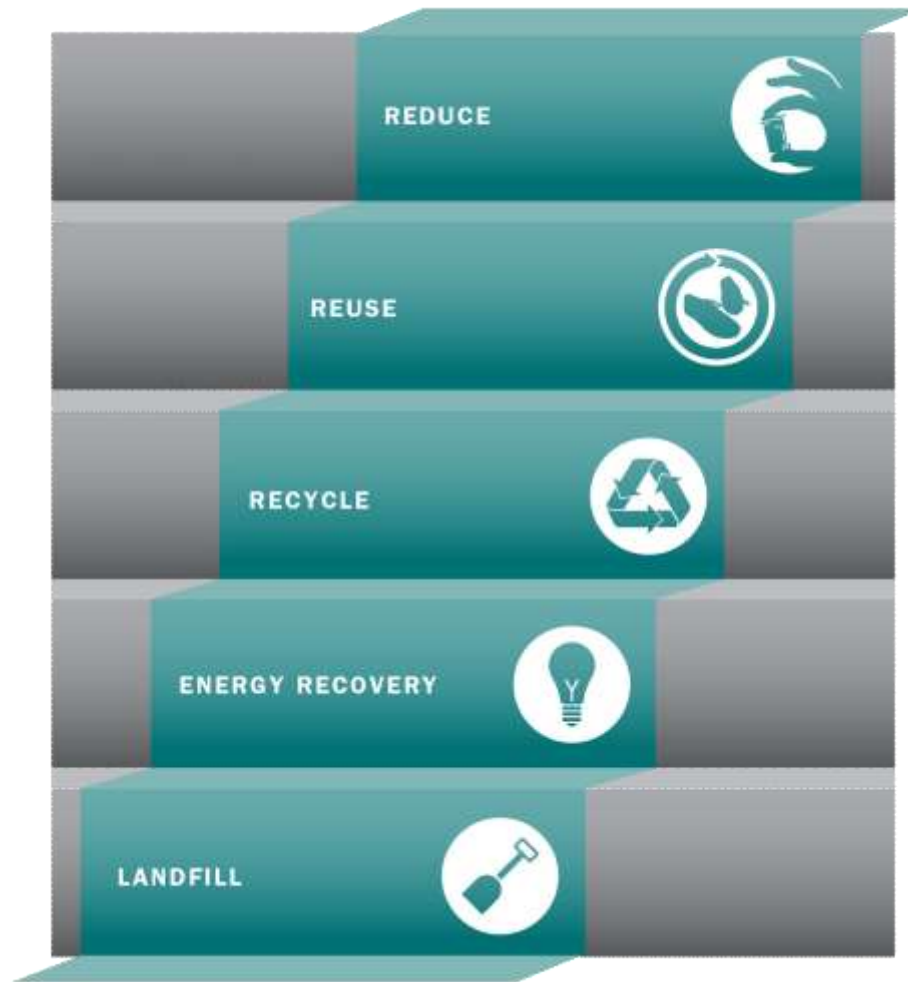
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Amounts of waste to landfills (tonnes)



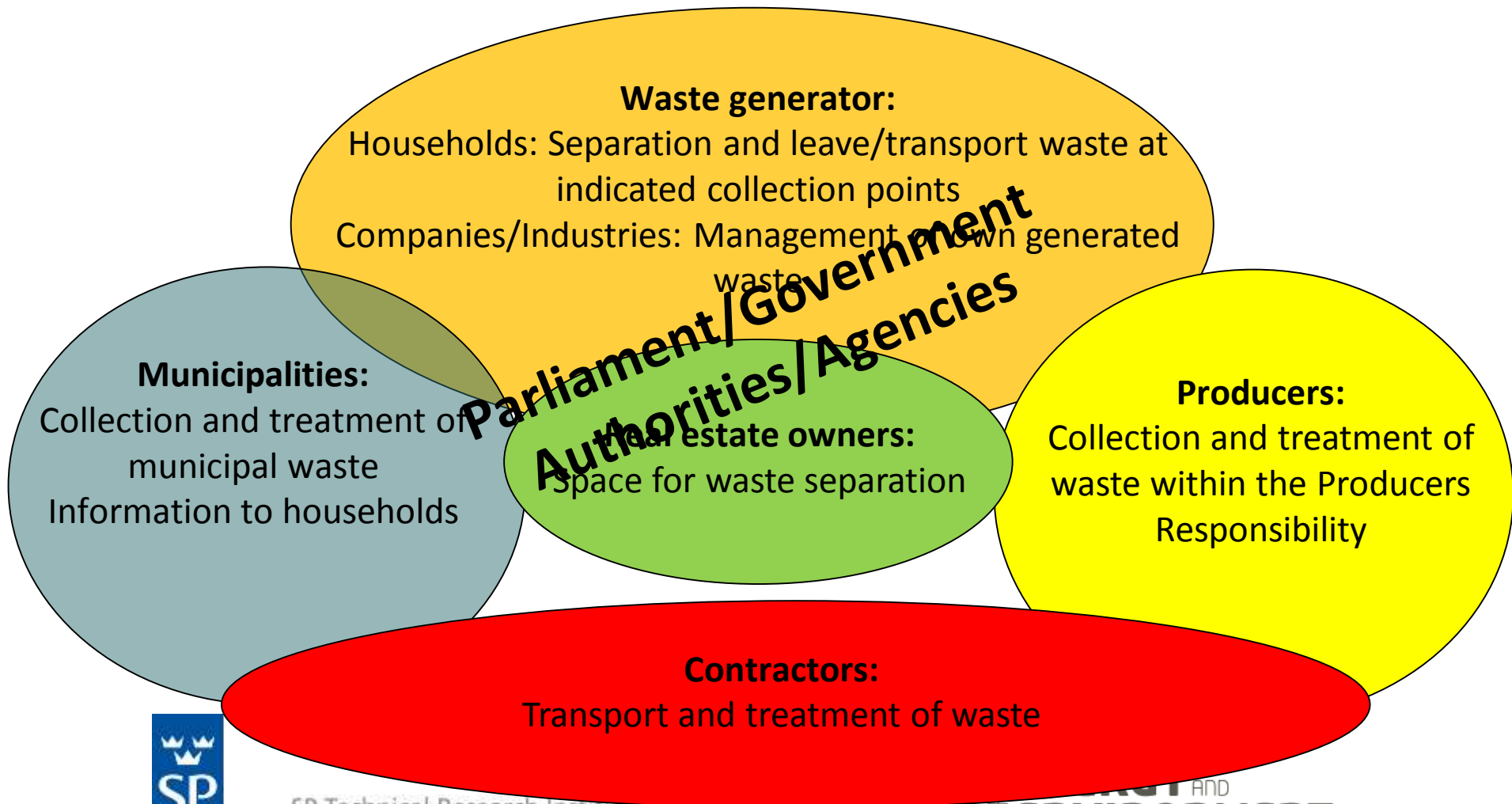
Waste hierarchy



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Roles within waste management



National waste management plan

- All EU member states must have a national waste management plan
- Swedish Environmental Protection Agency responsible
- Regulate waste management to become resource efficient
- Goals and activities to reach these goals
- Aims to
 - reduce waste amounts and the harmfulness of waste
 - better use resources in waste
 - prevent distribution of toxic substances



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The municipality's responsibility and organisation

The municipality is responsible for

- collection and treatment of household waste
- Including similar waste from restaurants, stores, offices, etc

Municipalities deal with their responsibility in different ways and design their own waste management organisation

Administration:

- Almost 50% have formed municipal waste management companies

Collection of municipal waste:

- 30% inhouse operation
- 70% contractors

Treatment of municipal waste:

- 35% inhouse operation
- 65% contractors, mainly municipally owned



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Packaging and newspaper collection



Coloured glass



Uncoloured glass



Metal



Paper/cardboard



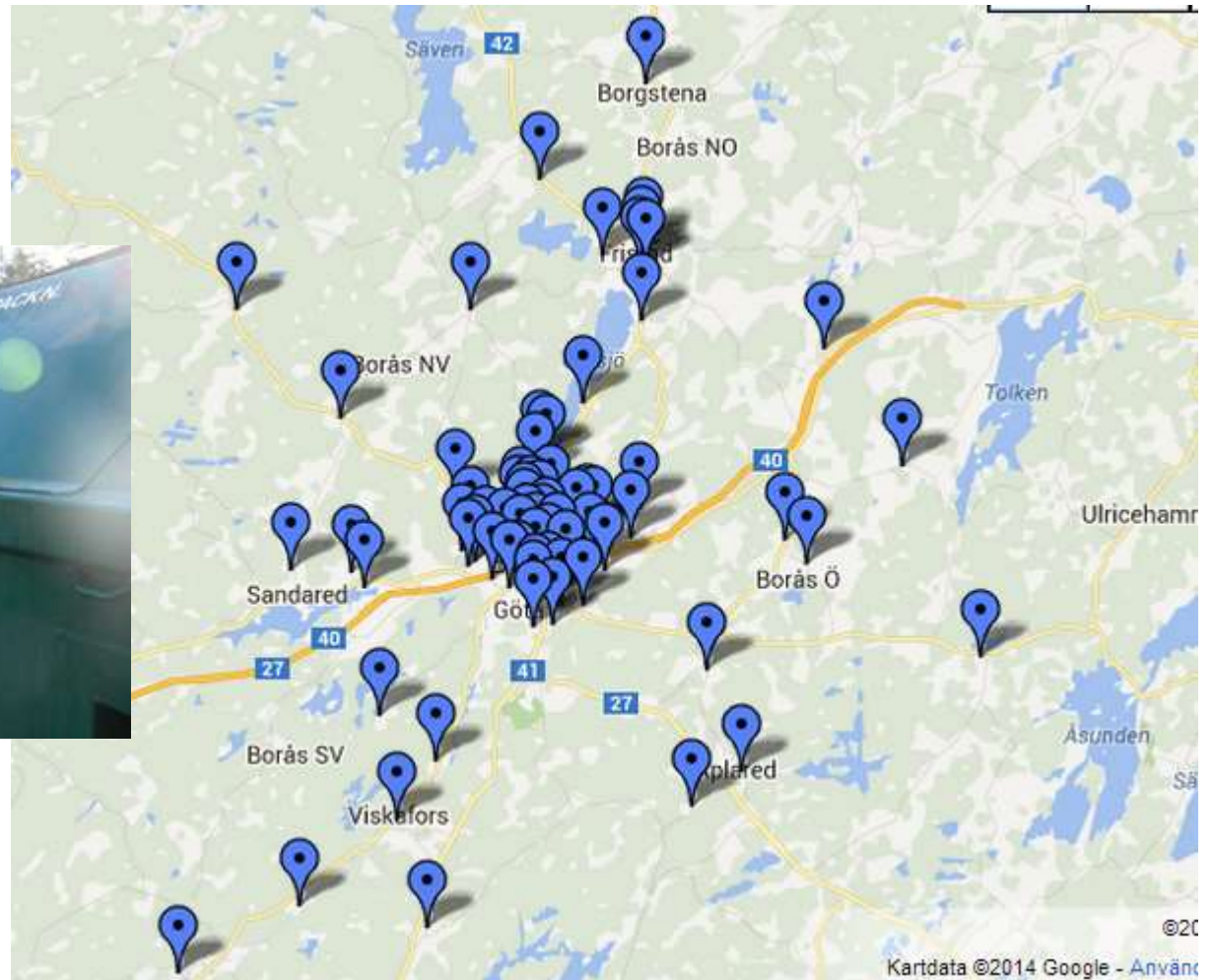
Plastic – soft/hard



Newspaper

Packaging and newspaper collection

77 stations in Borås



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Material recycling

Plastics



26 % → Flower pots, parts to car industry, construction materials, plastic bags etc

Metal



68 % → Engine parts, tins etc

Cardboard



75 % → New cardboard boxes, coating on gypsum boards

Glass



92 % → Bottles and isolation material



Newspaper and toilet paper



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Recycling centres



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Recycling centers

- Reuse/Secondhand
- Bulky waste
- Garden waste
- Hazardous waste
- Electronic waste
- Inert waste



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Household collection - curbside



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2 household bins



Organic



Combustible

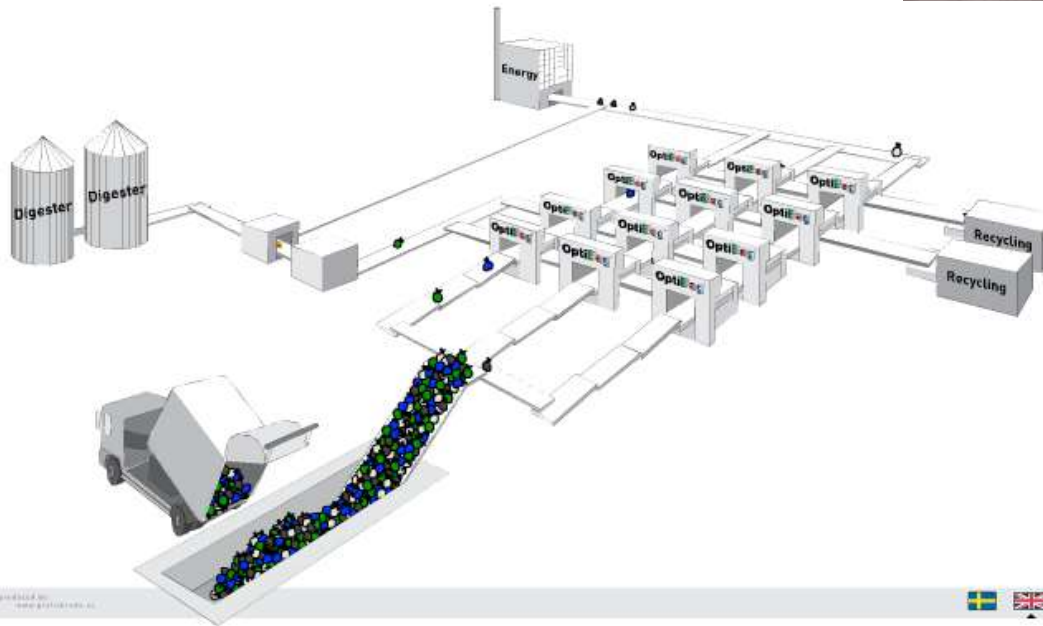


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The Optibag system

- Organic
 - Plastic packaging
 - Metal packaging
 - Paper packaging
 - Newspaper
 - Combustible
- Green
Orange
Grey
Yellow
Blue
White



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The Quattro Select System

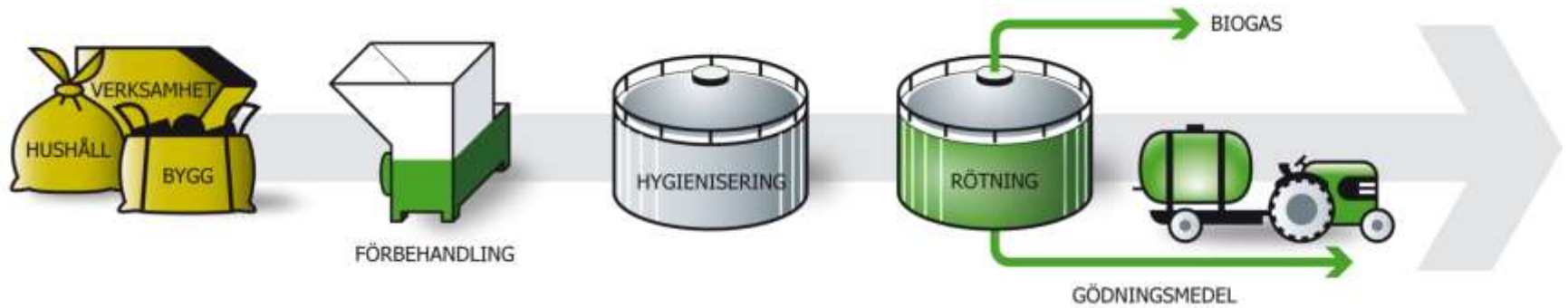


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Biological treatment

Anaerobic digestion



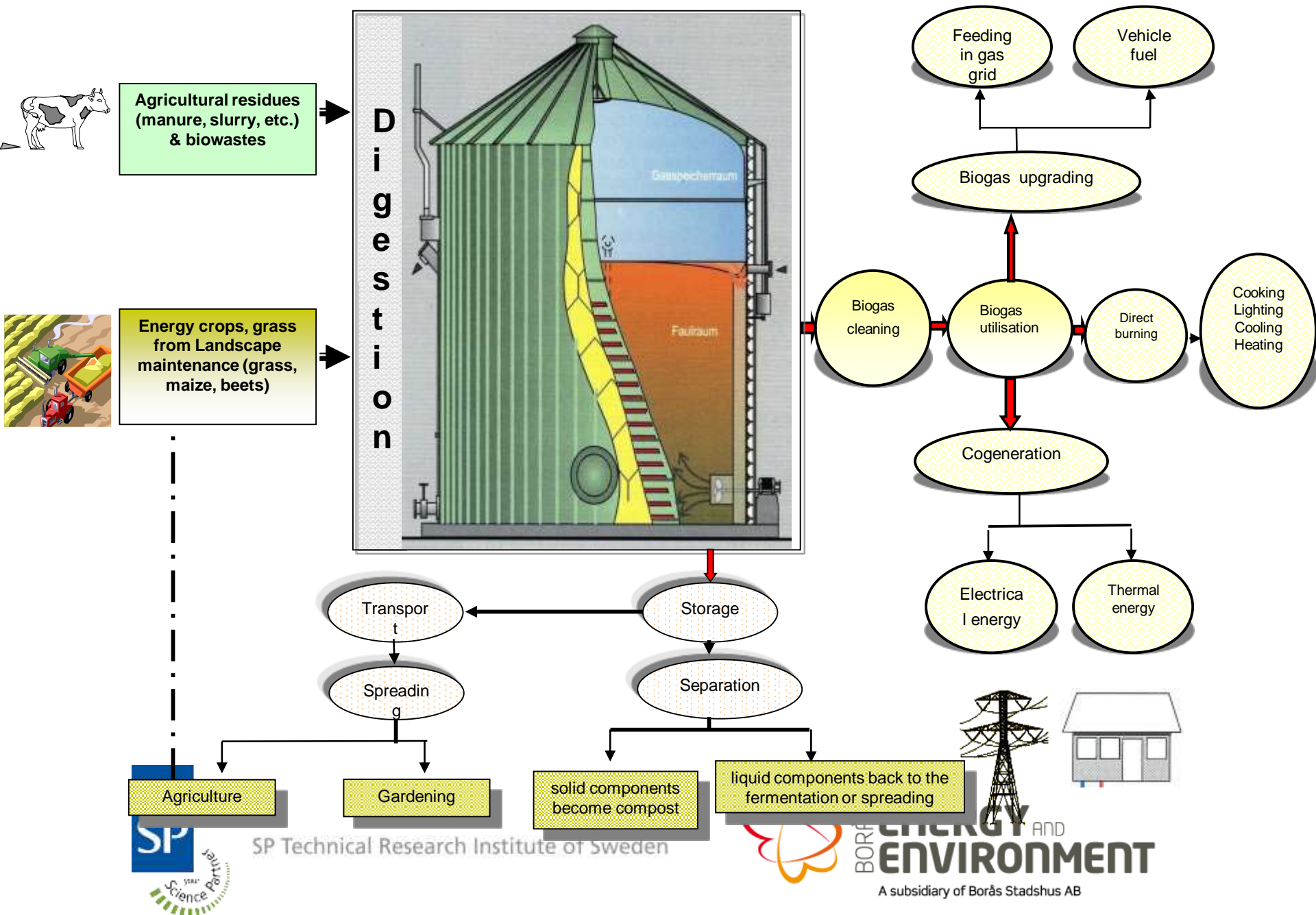
Composting



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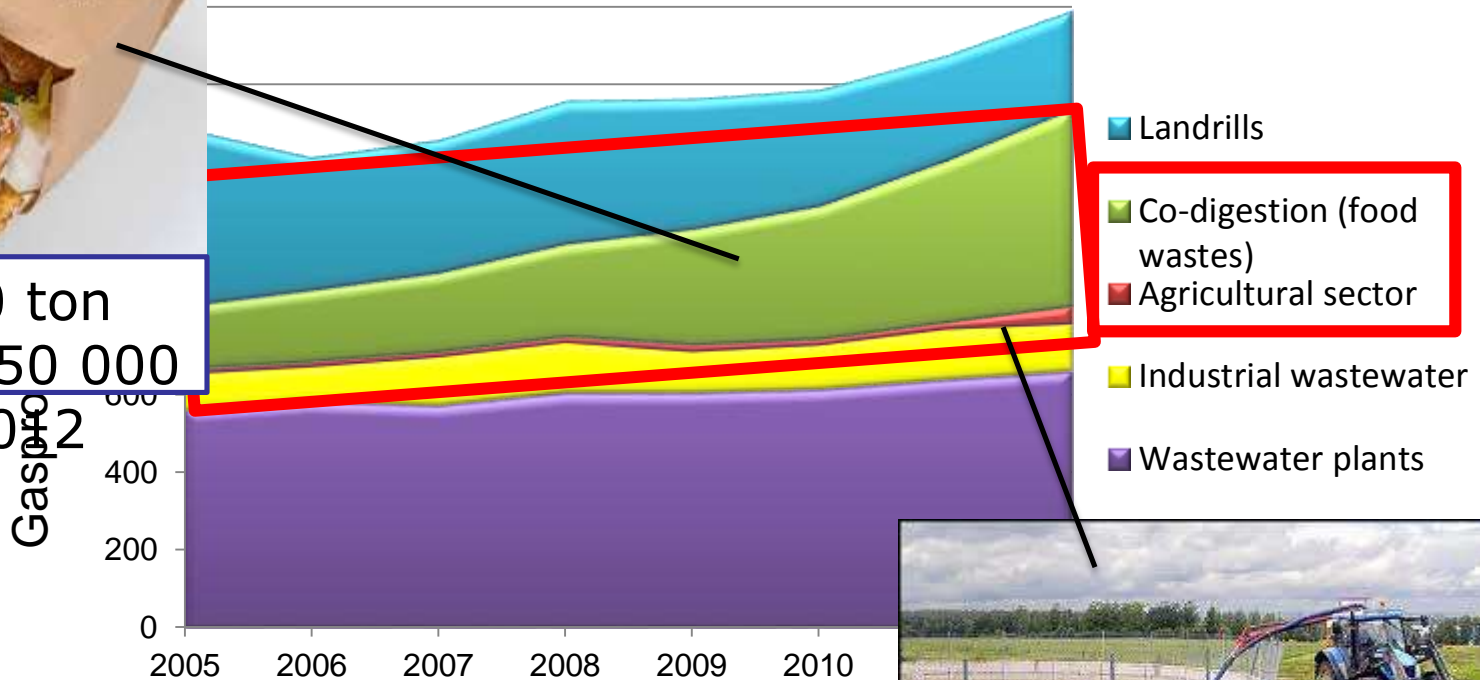
Overview of biogas industry



Biogas production in Sweden 2005-2012



30 000 ton
2005 – 250 000
ton 2012



Ref: SGC

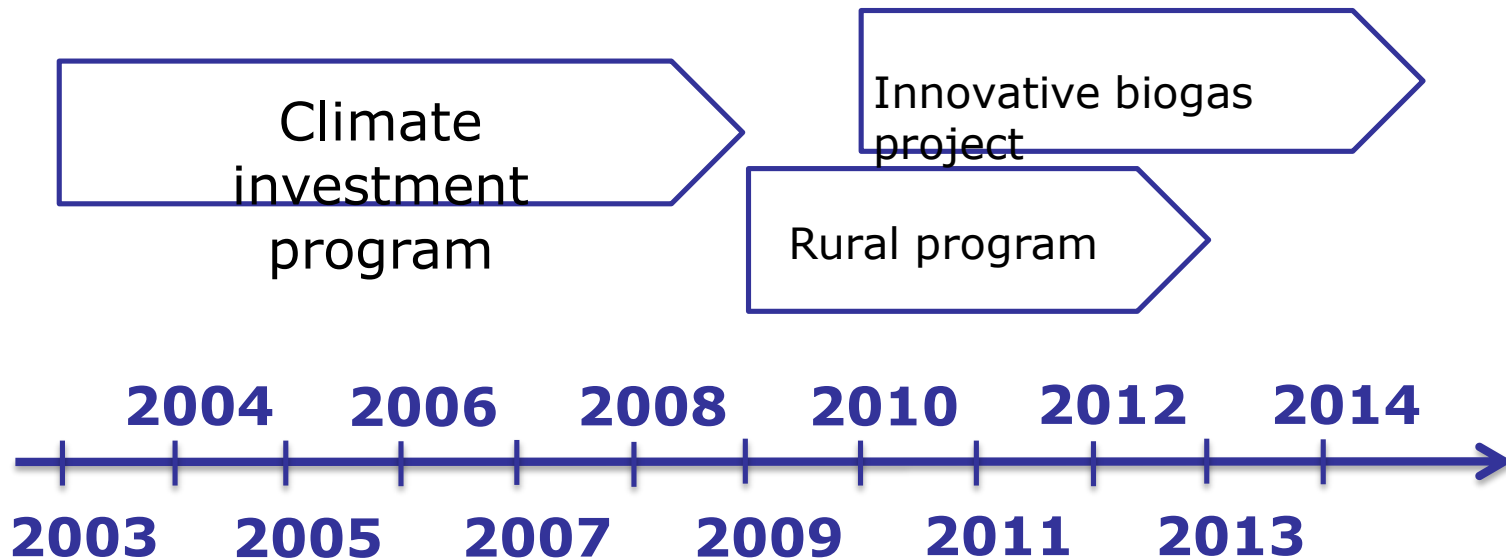


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Investment support by government

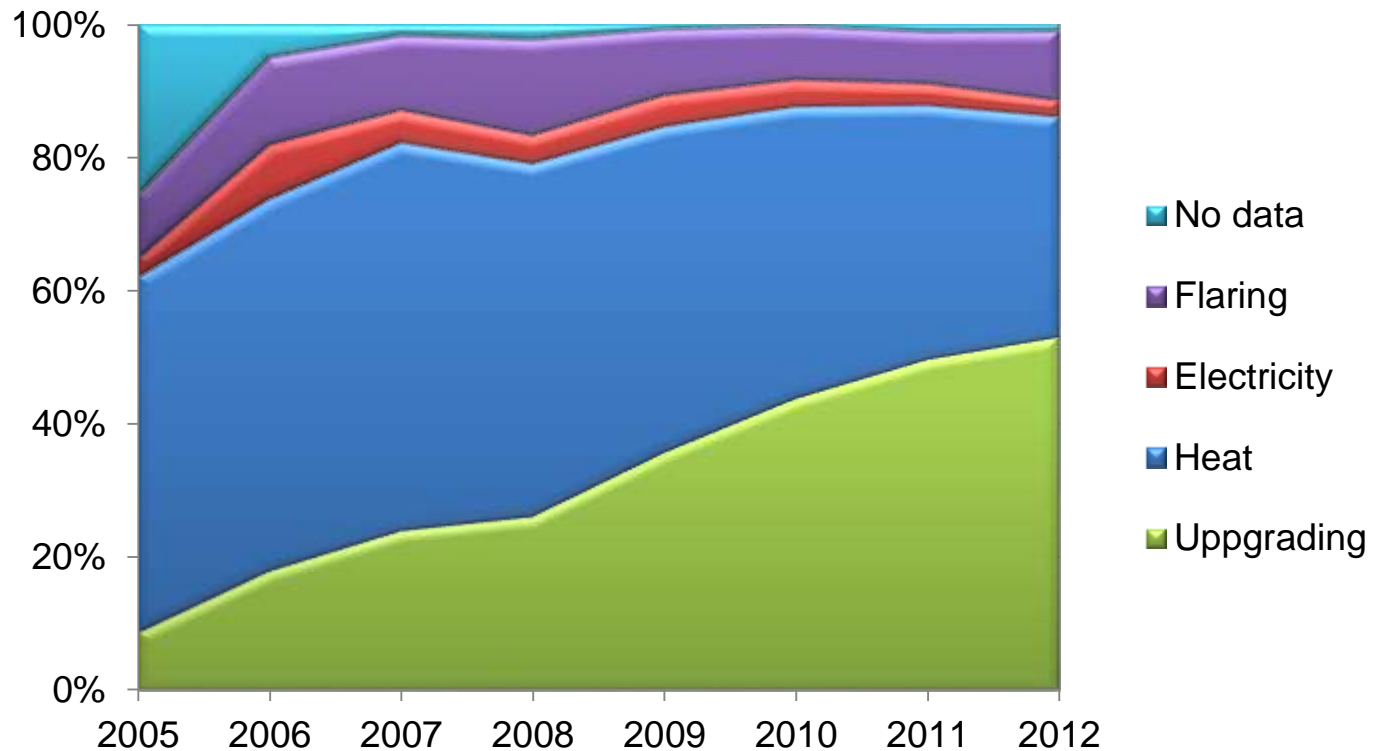


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Ref: Energigas Sverige- SGC
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Use of biogas in Sweden 2005-2012



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Biogas composition?

Matter	%
BioMethane, CH ₄	50-75
Carbon dioxide, CO ₂	25-50
<i>Nitrogen, N₂</i>	0-10
Hydrogen, H ₂	0-1
Hydrogen sulphide, H ₂ S	0-3
<i>Oxygen, O₂</i>	0-2

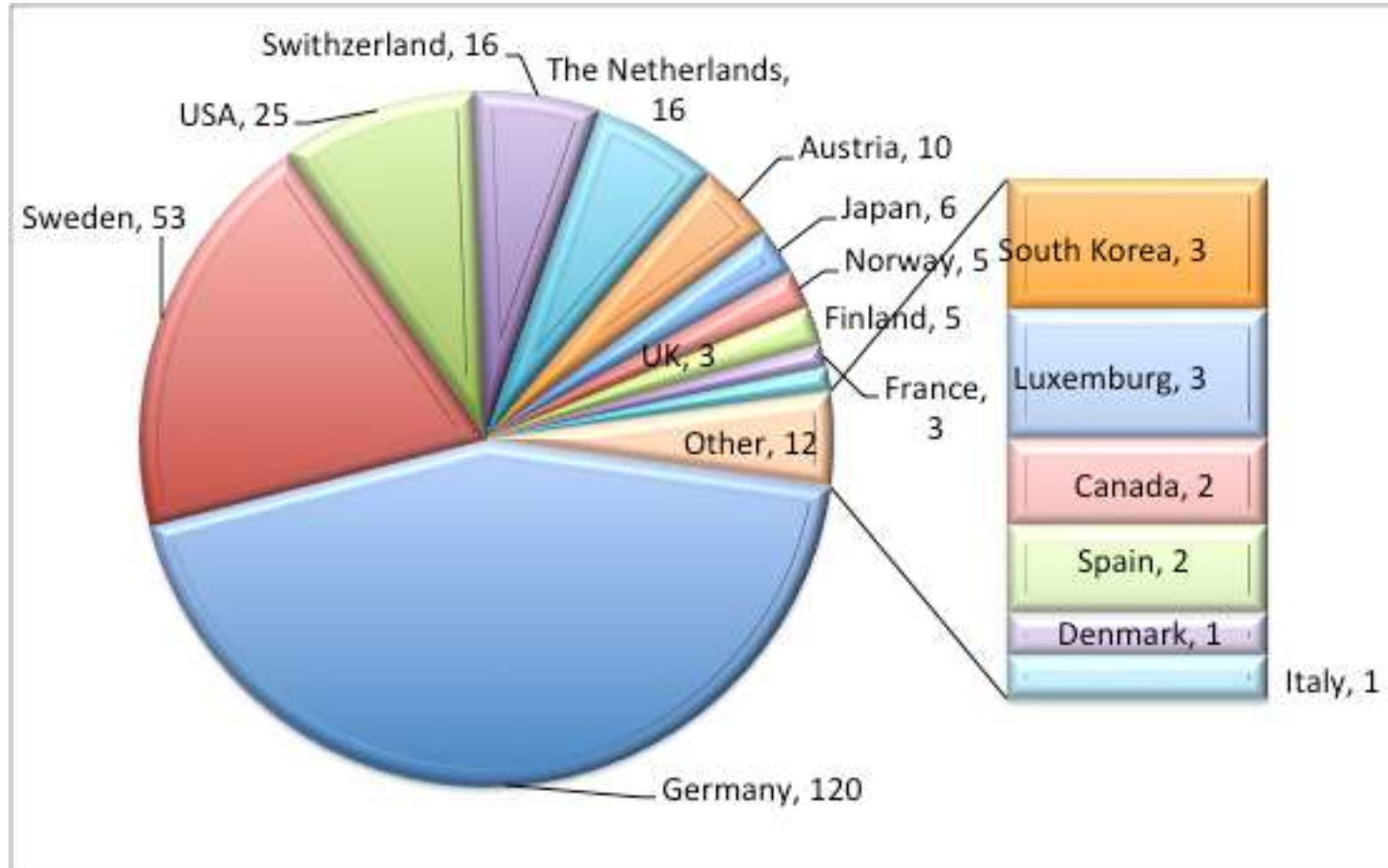
Demand for car fuels: Minimum 95-99% biomo



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Upgrading units in the world



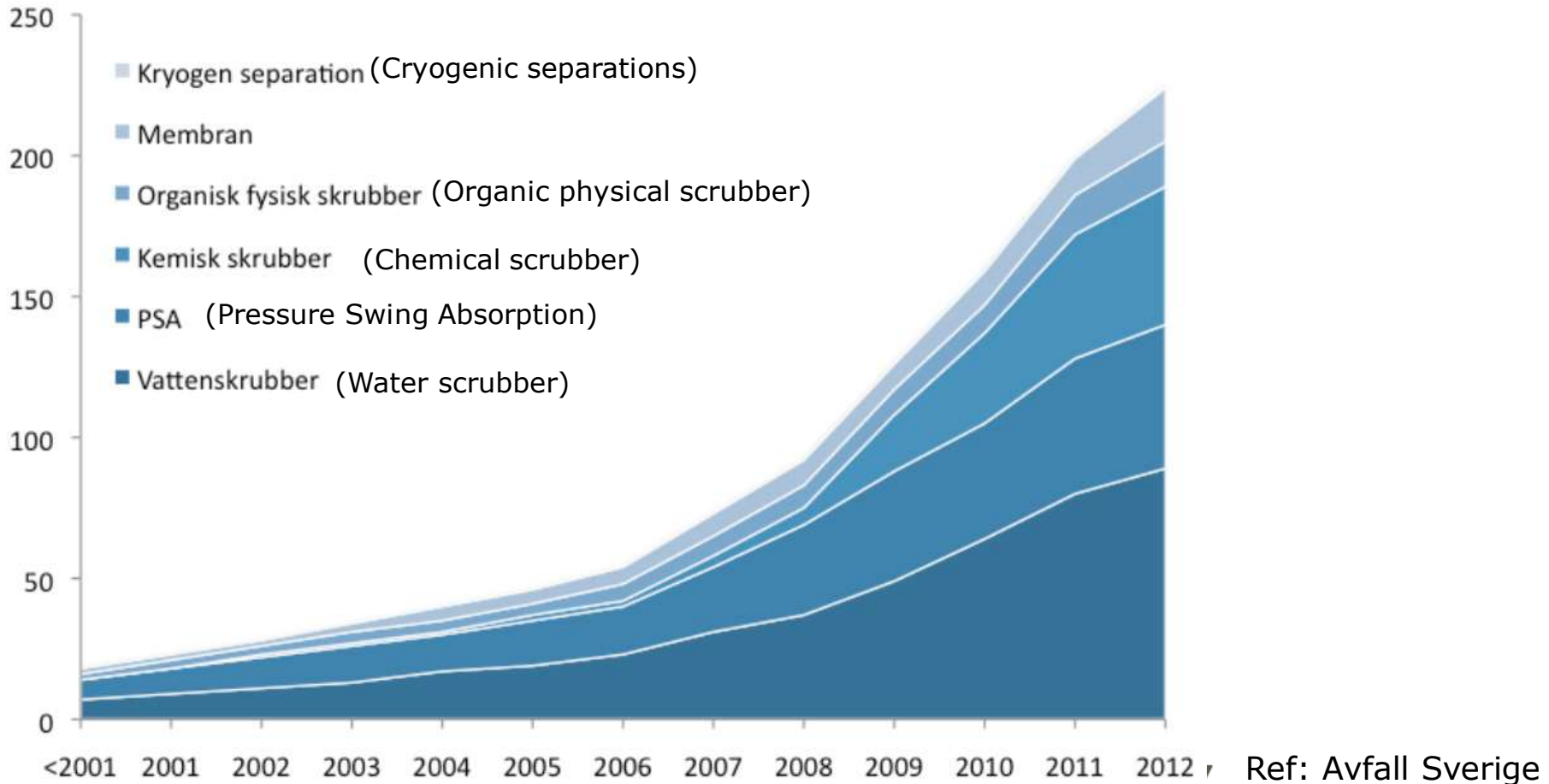
Ref: IEA Bioenergy Task 37 2014



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Different technology used for biogas upgrading



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Ref: Avfall Sverige

150 public gas stations in Sweden
50 for heavy trucks & busses
incl. 5 with Liquefied gas



Ref: Gasbilen.se &
SGC



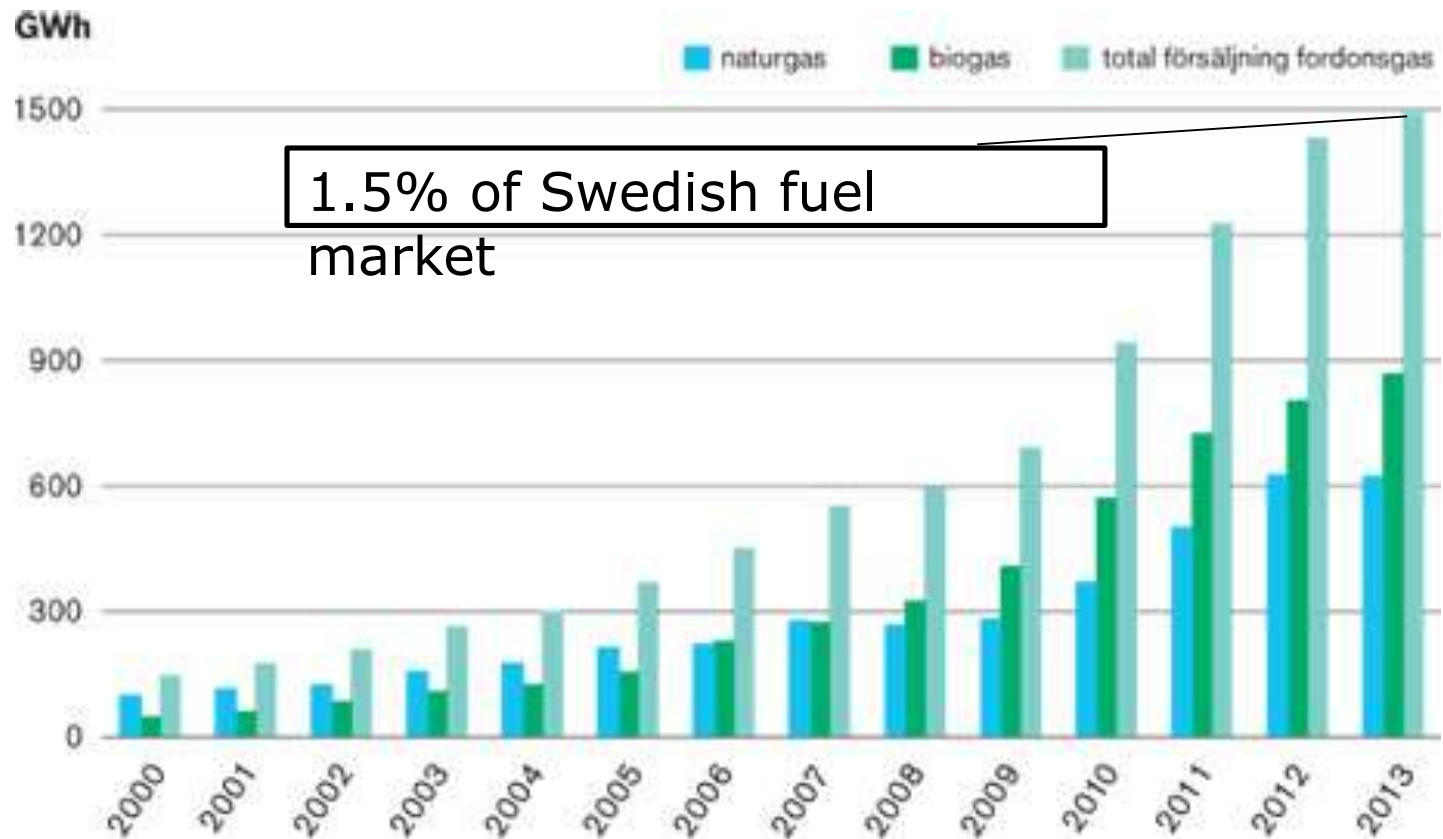
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ENVIRONMENT

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Biogas & natural gas selling in Sweden



Ref: Gasbilen.se



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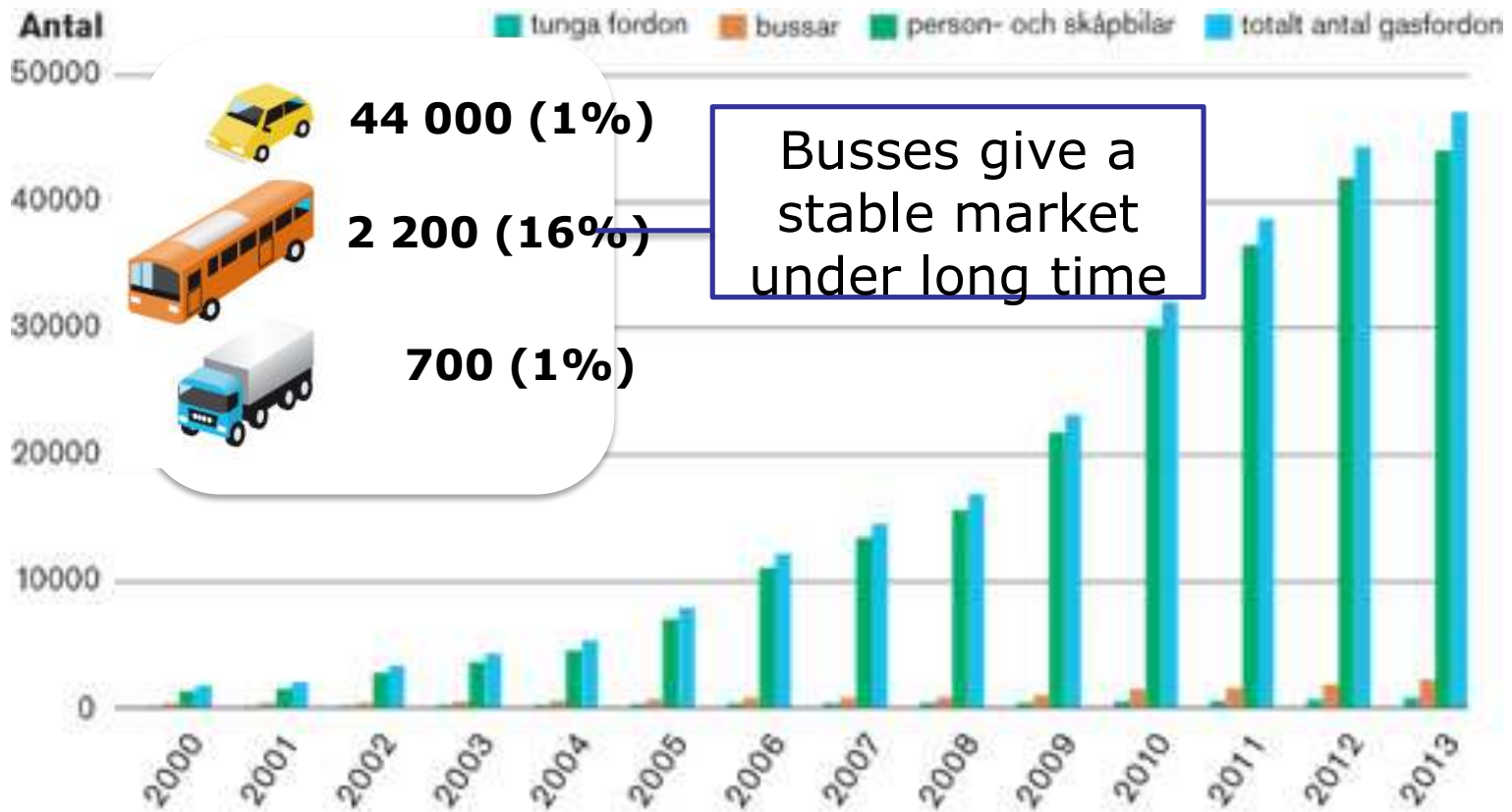


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Number of gas cars in Sweden

Rapid growth in the last 10 years



Ref: SGC



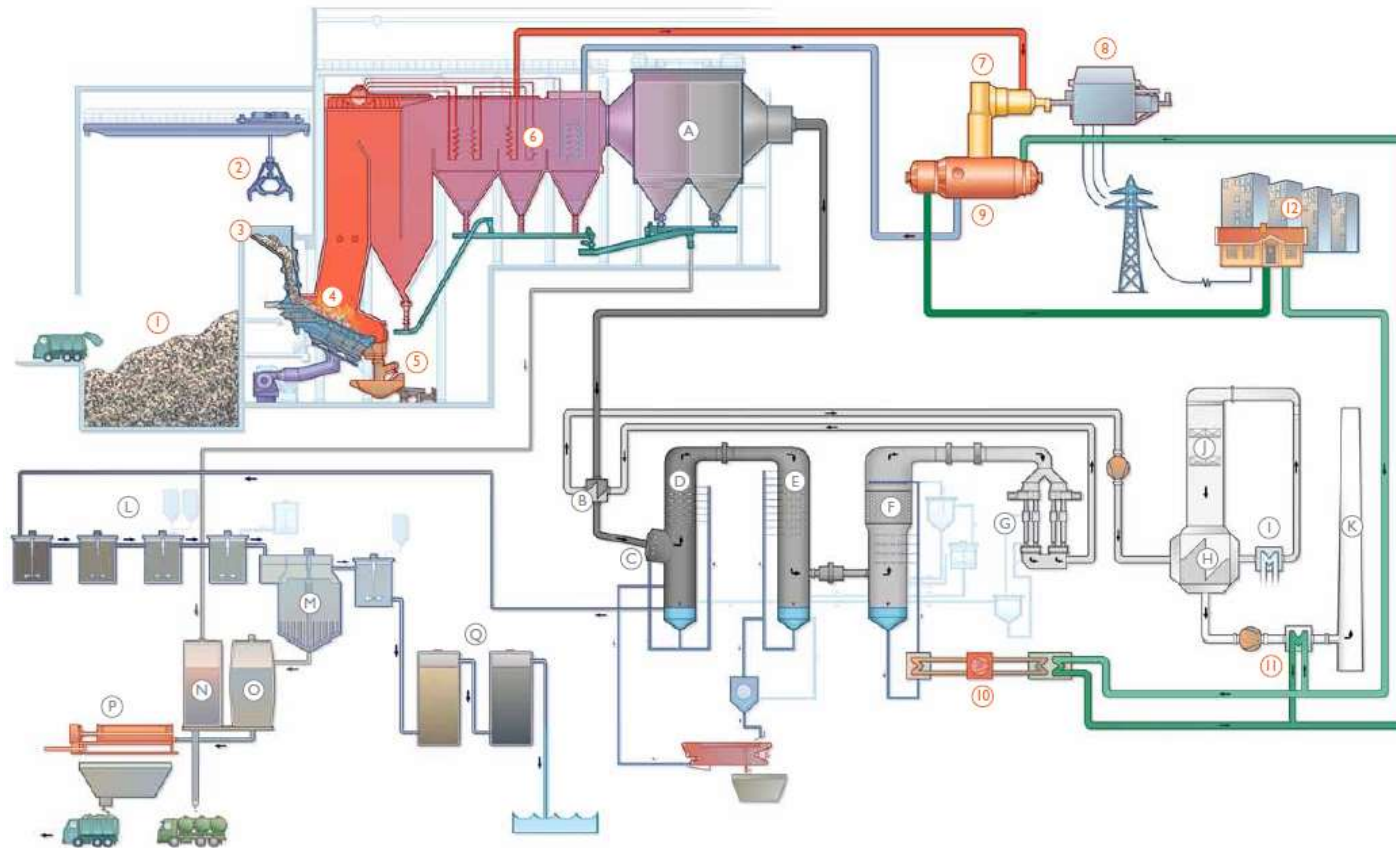
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Waste-to-Energy plant



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BORÅS RECYCLING MODEL



FOREST / BIOFUEL

HYDROPOWER PLANTS

ÖRESJÖ/VISKAN

GÄSSLÖSA SEWAGE PLANT

RYAVERKET

SOBACKEN WASTE
MANAGEMENT PLANT

BIOGAS PLANT

RESTAURANT/
INDUSTRY

BORÅS ZOO

BORÅS RECYCLING MODEL

Borås's burnable waste is transformed into district heating, district cooling and electricity at Ryaverket. Today around 35,000 of Borås's inhabitants heat their homes with district heating.

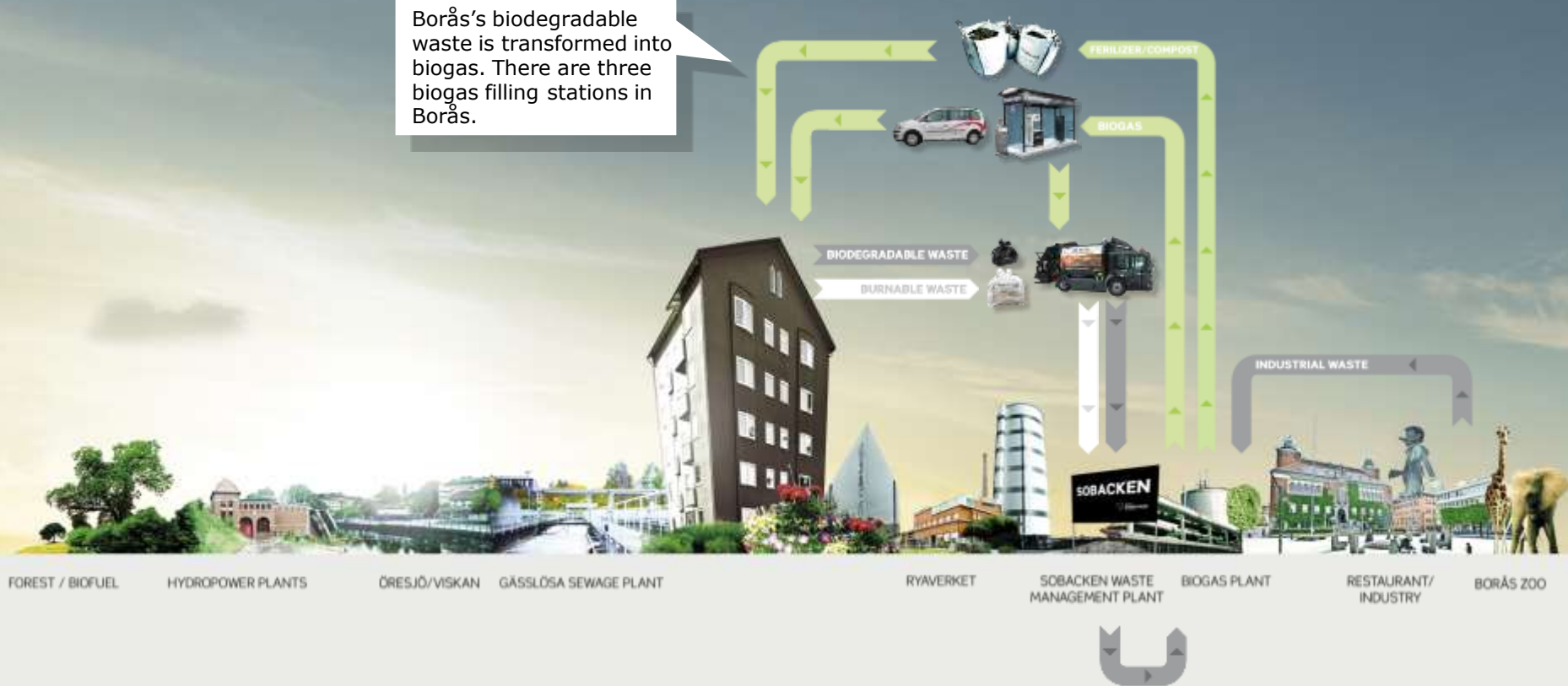


BORÅS RECYCLING MODEL



BORÅS RECYCLING MODEL

Borås's biodegradable waste is transformed into biogas. There are three biogas filling stations in Borås.



BORÅS RECYCLING MODEL



BORÅS RECYCLING MODEL

There are around 80 unmanned recycling stations in Borås owned by FTI (The packaging and newspaper collection service).



FOREST / BIOFUEL HYDROPOWER PLANTS ÖRESJÖ/VISKAN GÄSSLÖSA SEWAGE PLANT RYÄVERKET SOBÄCKEN WASTE MANAGEMENT PLANT BIOGAS PLANT RESTAURANT/INDUSTRY BORÅS ZOO

BORÅS RECYCLING MODEL



There are 5 manned recycling centrals in Borås. Business customers may use one of the recycling centrals.

FOREST / BIOFUEL HYDROPOWER PLANTS ÖRESJÖ/VISKAN GÄSSLÖSA SEWAGE PLANT RYÄVERKET SOBÄCKEN WASTE MANAGEMENT PLANT BIOGAS PLANT RESTAURANT/INDUSTRY BORÅS ZOO

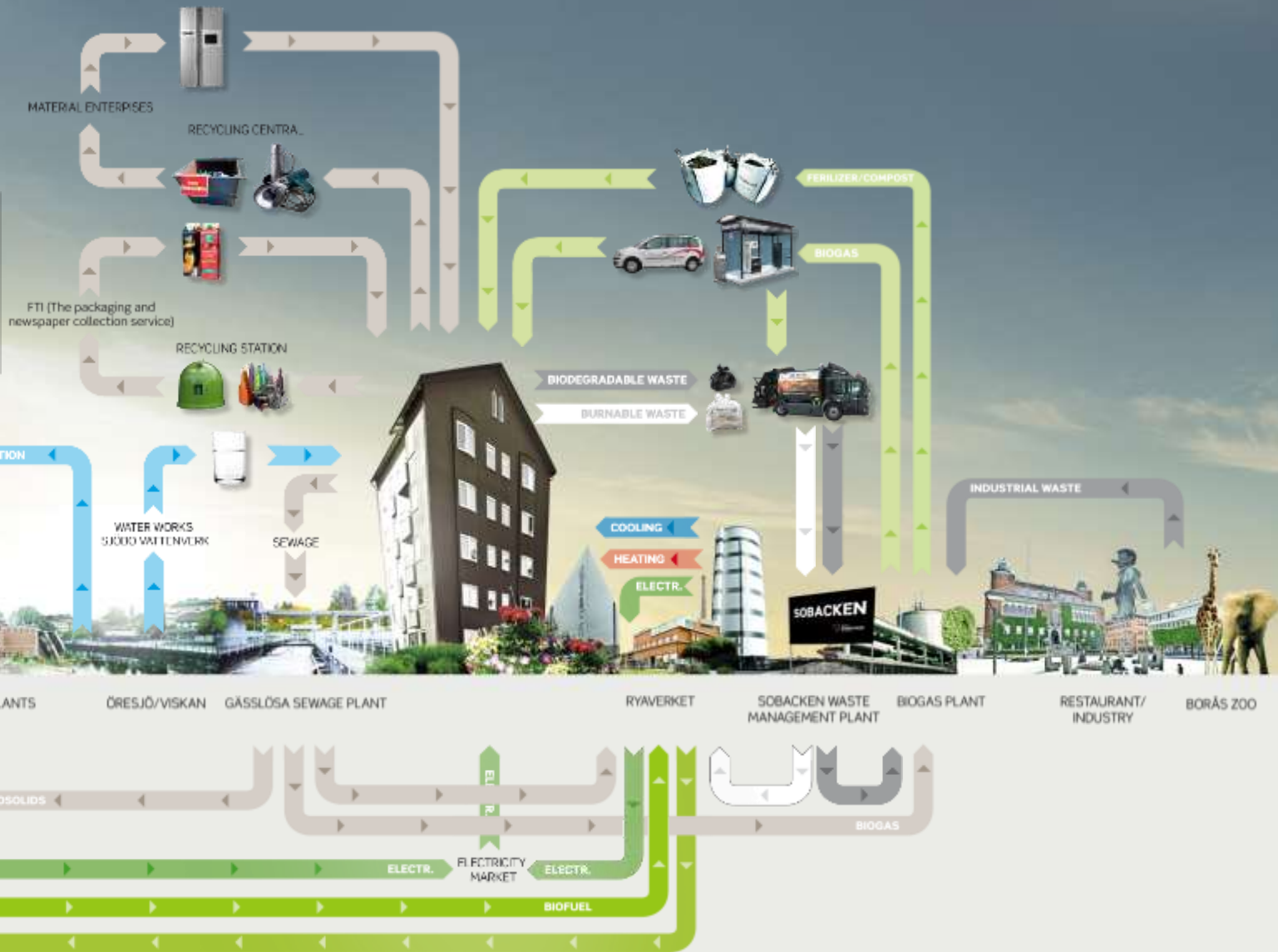
BORÅS RECYCLING MODEL

Water purification takes place at the Sjöbo water treatment plant, which supplies water to Borås's inhabitants.



BORÅS RECYCLING MODEL

An Environmental Impact Assessment has been submitted for the erection of 6 wind turbines in Rångedala.



Accumulated household waste in Borås

Facts:

This "waste-mountain" represents all the household waste that is produced in Borås every year.

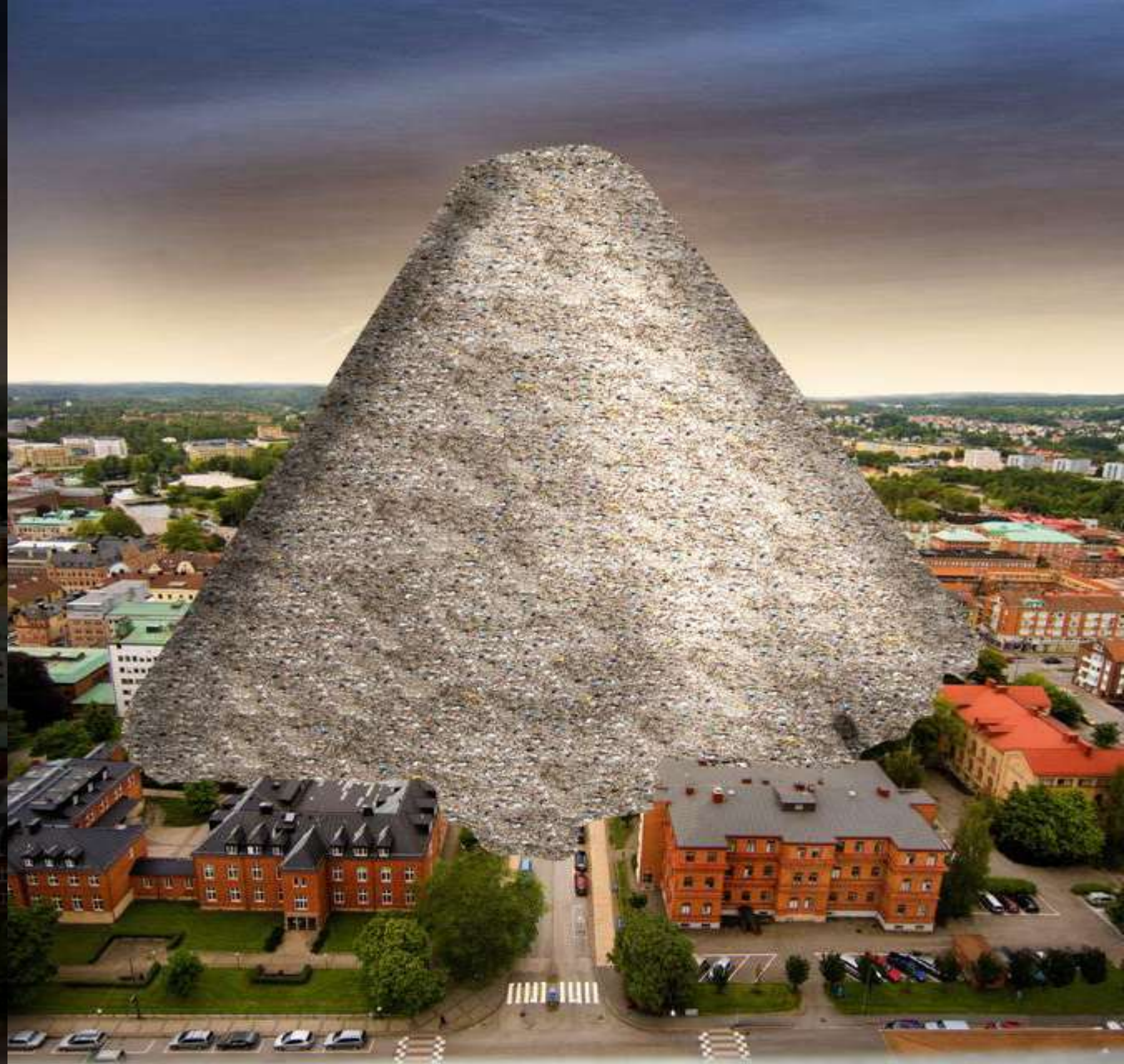
>99% goes to either recycling, or energy recovery.

Data:

Weight: 44 000 tonnes

Volume: 300 000 m³

Hight: 130 m



Sobacken Waste Management Facility

Biological Treatment

Hazardous waste

Weighing station

Contaminated Soils Treatment

Reception

Landfill

Preparation of Combustible Waste

Leachate Pond

Waste economy in Borås City

- Waste taxation in Borås , a non-profit system
 - >35% Transports (Collecting)
 - 20% Treatment
 - 20% Recycling Centres
 - 5% Sorting (Black/White bags)
 - Rest. Overhead costs
- **Fixed rate** and dynamic rate, Borås 2013:
 - $1309 + 921 - 1567 = 2230 - 2876$ SEK/year ($\sim 250 - 325$ €/year)
- Waste tax as a management control measure
 - Based on weight of waste
 - Mandatory or driven by cost



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Economy and business in waste management

- Business is selling energy:
 - Biogas (busses, trucks, cars)
 - Heating (private persons, companies/industries)
 - Cooling (industries)
 - Electricity (Nordic electricity market – Nord Pool)



▪ Laws/ordinances



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Waste Recovery International Partnership in Borås



Sustainable
cityplanning

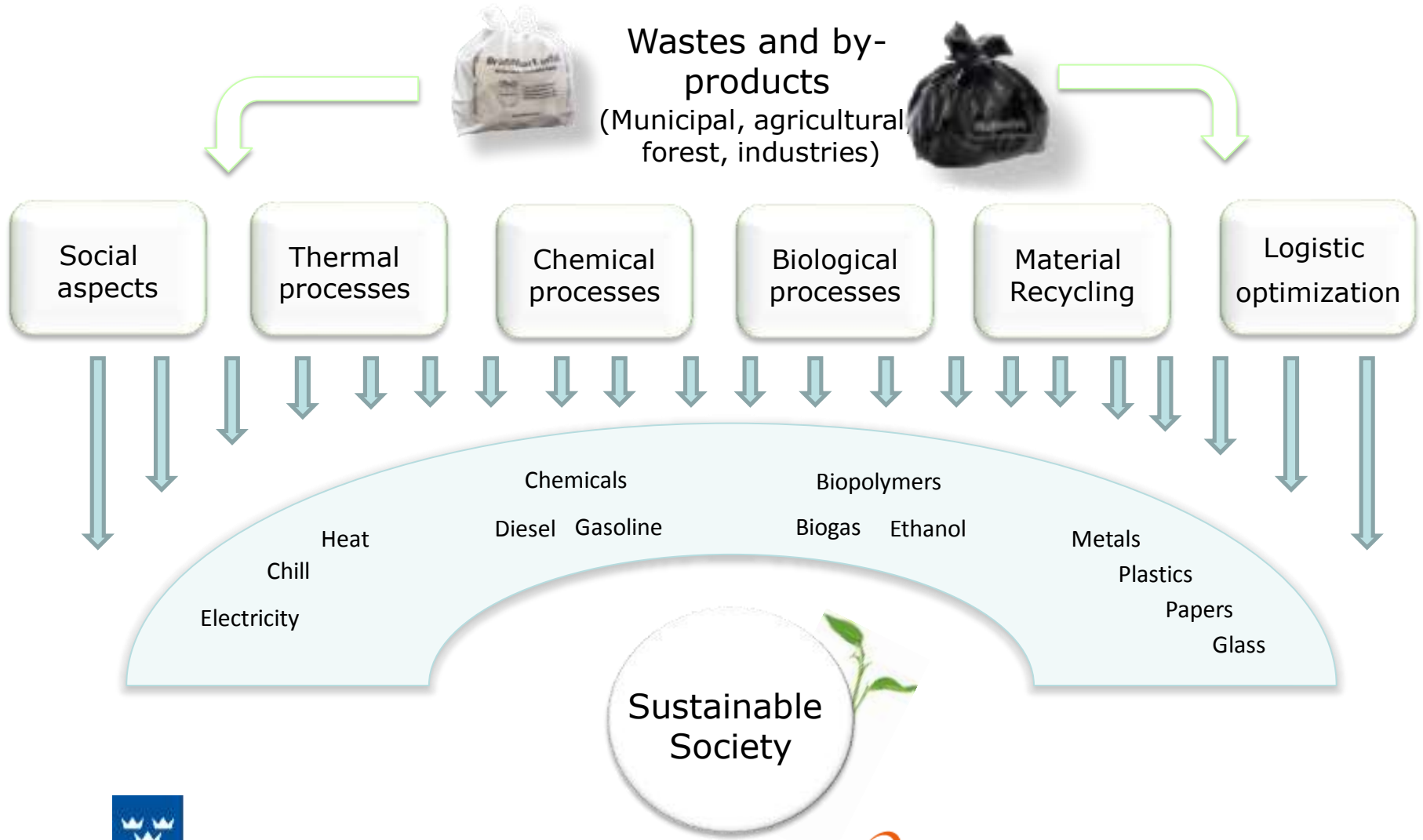
Knowledge transfer
and research

Strategic
environmental
development

Training program
Capacity building



University Research Profile “Resource Recovery”



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**MSc program in
Resource Recovery**
two international master programs

Industrial Biotechnology

Polymer Technology

Energy Engineering

Sustainable Engineering



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PhD program in Resource Recovery

PhD-program



A multidisciplinary PhD-program with specialities in:

- Biotechnology
- Polymer technology
- Energy technology
- Simulation technologies
- Social aspects



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Our vision:

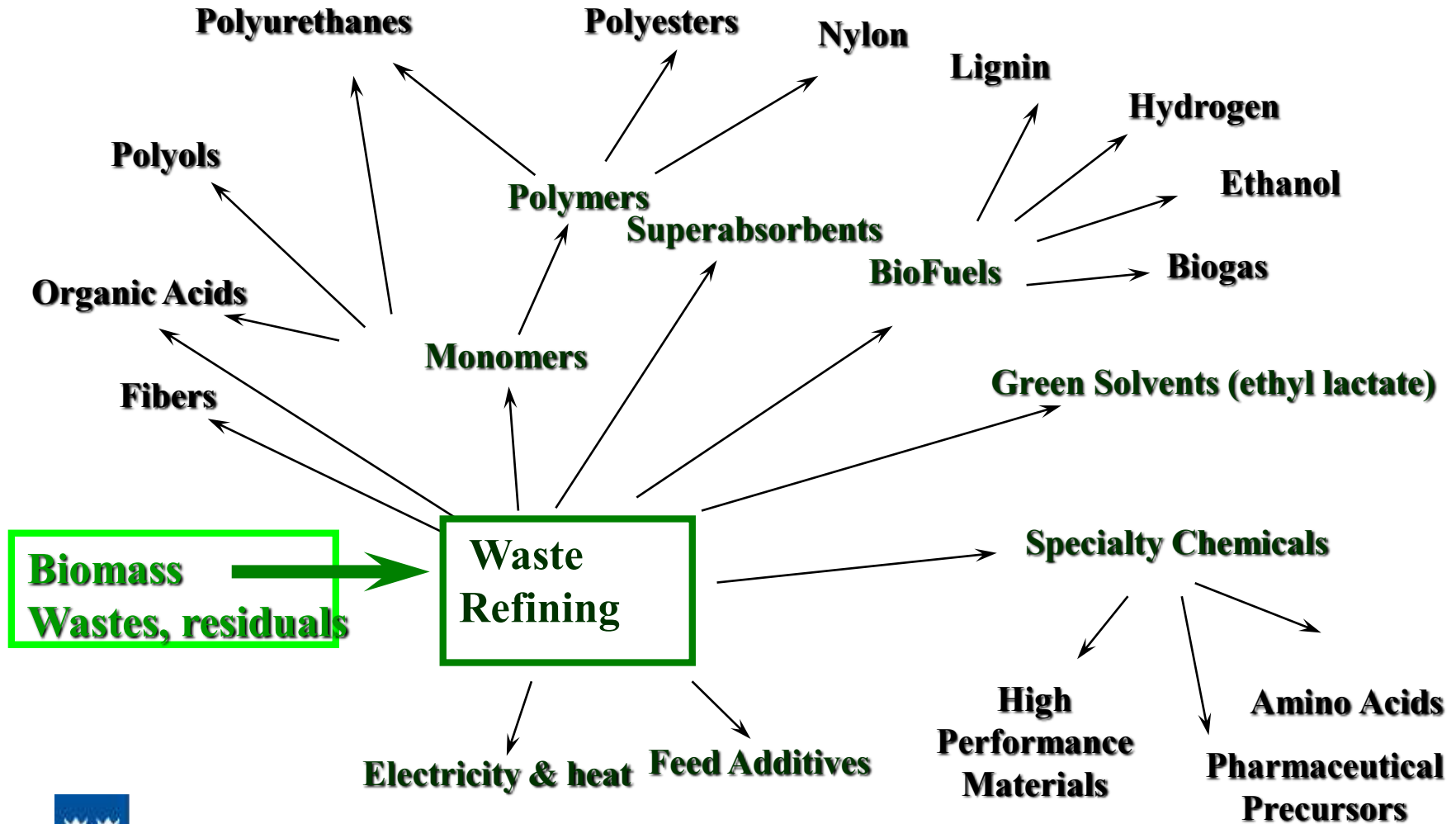
**Waste is a "Resource"
but our knowledge is not
enough to utilize it!**



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Our vision



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